



Title	Four Car Fires		
Test Type	Custom		
Lab Number	04FE0001-1		
Test dates	4/20/04, 4/21/04, 5/18/04, 5/19/04	No. Tests	4

Thermocouples

Thermocouples are temperature measurement sensors that consist of two dissimilar metals joined at one end (a junction) that produces a small thermo-electrical voltage when the wire is heated. The change in voltage is interpreted as a change in temperature [1]. There are many configurations of thermocouples which affect the temperature range, ruggedness, and response time. The information required to identify these factors for the thermocouples that were used during the experiment(s) conducted for this test series is provided in the "Thermocouple Measurement Description" table.

Thermocouples used during this test series were used in accordance with the method defined in FRL laboratory instruction "LI001 Thermocouple" [2].

The following table provides a description of the instrumentation used to collect the temperature measurements during the experiments. The "Description" column describes the location of the temperature measurement. The "Thermocouple Type" describes the characteristics of the thermocouple used.

Table 1. Thermocouple Measurement Description

Description	Thermocouple type
engine compartment (firewall)	Type K, Glass Ins., 24 AWG wire
steering wheel 2	Type K, Glass Ins., 24 AWG wire
head liner (center of car)	Type K, Glass Ins., 24 AWG wire
back seat head rest	Type K, Glass Ins., 24 AWG wire
trunk	Type K, Glass Ins., 24 AWG wire
passenger side wheel well	Type K, Glass Ins., 24 AWG wire
driver side wheel well	Type K, Glass Ins., 24 AWG wire
center console vent	Type K, Glass Ins., 24 AWG wire
defogger vent (along windshield)	Type K, Glass Ins., 24 AWG wire
headliner lamp	Type K, Glass Ins., 24 AWG wire
Steering Wheel	Type K, Glass Ins., 24 AWG wire
Parking Brake Handle	Type K, Glass Ins., 24 AWG wire
Sunroof	Type K, Glass Ins., 24 AWG wire
Rear Seat Headrest (Passenger Side)	Type K, Glass Ins., 24 AWG wire
Rear Seat Cushion (Driver Side)	Type K, Glass Ins., 24 AWG wire
Trunk	Type K, Glass Ins., 24 AWG wire
Driver Side Wheel Well	Type K, Glass Ins., 24 AWG wire
Radiator Cap	Type K, Glass Ins., 24 AWG wire
Fire Wall	Type K, Glass Ins., 24 AWG wire
Throttle Body	Type K, Glass Ins., 24 AWG wire
Passabger Side Wheel Well	Type K, Glass Ins., 24 AWG wire

Experiment Photographs

Digital Cameras are used within the FRL to record digital still photographs during experiments. Digital Cameras used during this test series were used in accordance with the method defined in FRL Laboratory Instruction “LI003 Digital Cameras” [3].

Results for Test 1 (ID 439)

The following table provides a summary of the temperature results. The “Initial” column provides the measured temperature at the beginning of the test. The maximum temperature recorded during the test is provided in the “Max” column. The remaining columns provide the calculated maximum average temperatures.

Table 2. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second maximum average (C)	60 second maximum average (C)	300 second maximum average (C)	600 second maximum average (C)
Steering Wheel	25	284	279	269	238	190
Parking Brake Handle	25	258	250	236	175	122
Sunroof	25	701	591	570	543	364
Rear Seat Headrest (Passenger Side)	25	359	334	309	281	274
Rear Seat Cushion (Driver Side)	25	891	862	799	523	410
Trunk	25	373	360	359	343	291

The following chart(s) present a time-dependent representation of the instantaneous temperatures measured during the experiment.

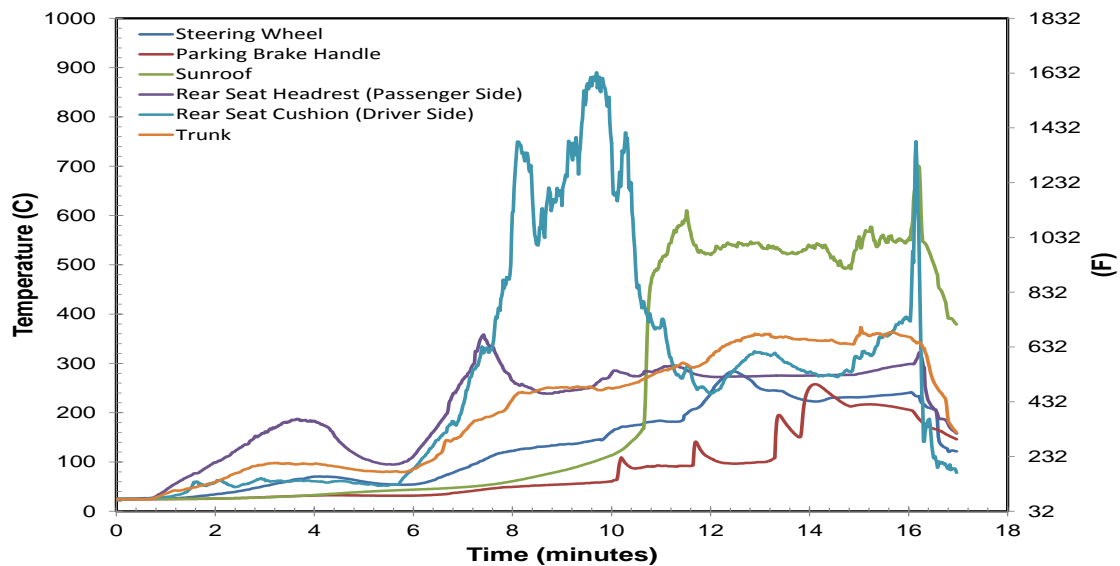


Figure 1. Temperature

Results for Test 2 (ID 442)

The following table provides a summary of the temperature results. The “Initial” column provides the measured temperature at the beginning of the test. The maximum temperature recorded during the test is provided in the “Max” column. The remaining columns provide the calculated maximum average temperatures.

Table 3. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second maximum average (C)	60 second maximum average (C)	300 second maximum average (C)	600 second maximum average (C)
Driver Side Wheel Well	22	398	383	364	214	0
Radiator Cap	22	705	656	636	286	0
Fire Wall	22	602	575	554	359	0
Throttle Body	22	36	36	35	31	0
Passabger Side Wheel Well	22	170	146	141	81	0
Steering Wheel	22	58	48	44	33	0

The following chart(s) present a time-dependent representation of the instantaneous temperatures measured during the experiment.

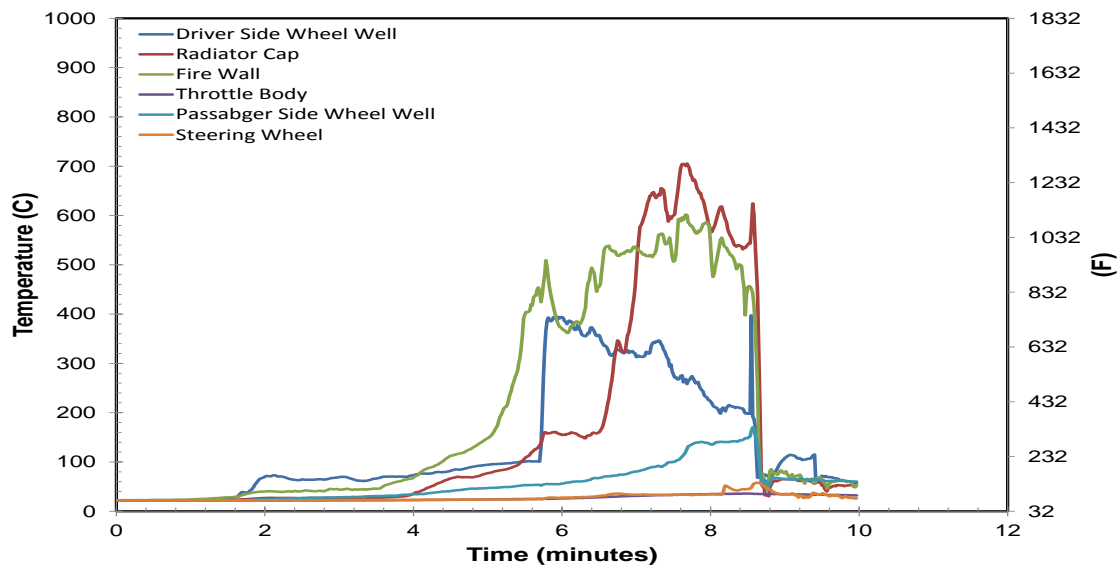


Figure 2. Temperature

Results for Test 3 (ID 415)

The following table provides a summary of the temperature results. The “Initial” column provides the measured temperature at the beginning of the test. The maximum temperature recorded during the test is provided in the “Max” column. The remaining columns provide the calculated maximum average temperatures.

Table 4. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second maximum average (C)	60 second maximum average (C)	300 second maximum average (C)	600 second maximum average (C)
passenger side wheel well	20	101	96	93	59	40
driver side wheel well	21	809	779	743	673	428
center console vent	21	88	85	82	45	33
defogger vent (along windshield)	21	102	98	94	66	45
headliner lamp	21	525	477	475	207	114
back seat head rest	21	134	127	123	71	46

The following chart(s) present a time-dependent representation of the instantaneous temperatures measured during the experiment.

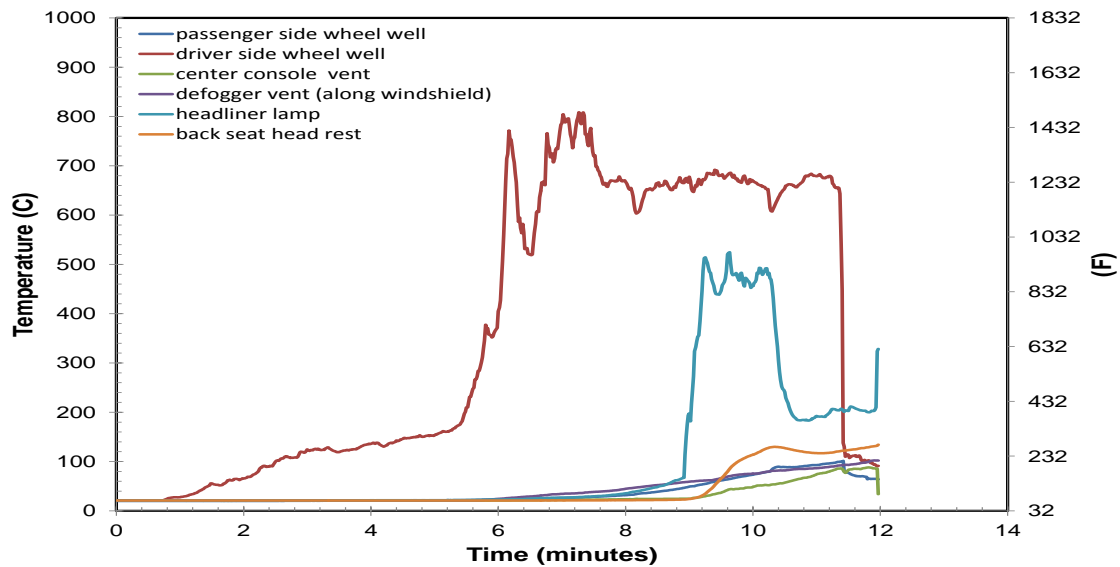


Figure 3. Temperature

Results for Test 4 (ID 416)

The following table provides a summary of the temperature results. The “Initial” column provides the measured temperature at the beginning of the test. The maximum temperature recorded during the test is provided in the “Max” column. The remaining columns provide the calculated maximum average temperatures.

Table 5. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second maximum average (C)	60 second maximum average (C)	300 second maximum average (C)	600 second maximum average (C)
engine compartment (firewall)	20	81	76	71	39	30
steering wheel 2	20	864	851	845	529	350
head liner (center of car)	20	878	840	835	715	545
back seat head rest	19	1289	911	763	599	434
trunk	19	880	546	291	79	49

The following table shows which thermocouple(s) were taken out of service during the experiment.

Table 6. Out of Service Times

Description	Time out of service (s)
engine compartment (firewall)	620
steering wheel 2	620
head liner (center of car)	620

The following chart(s) present a time-dependent representation of the instantaneous temperatures measured during the experiment.

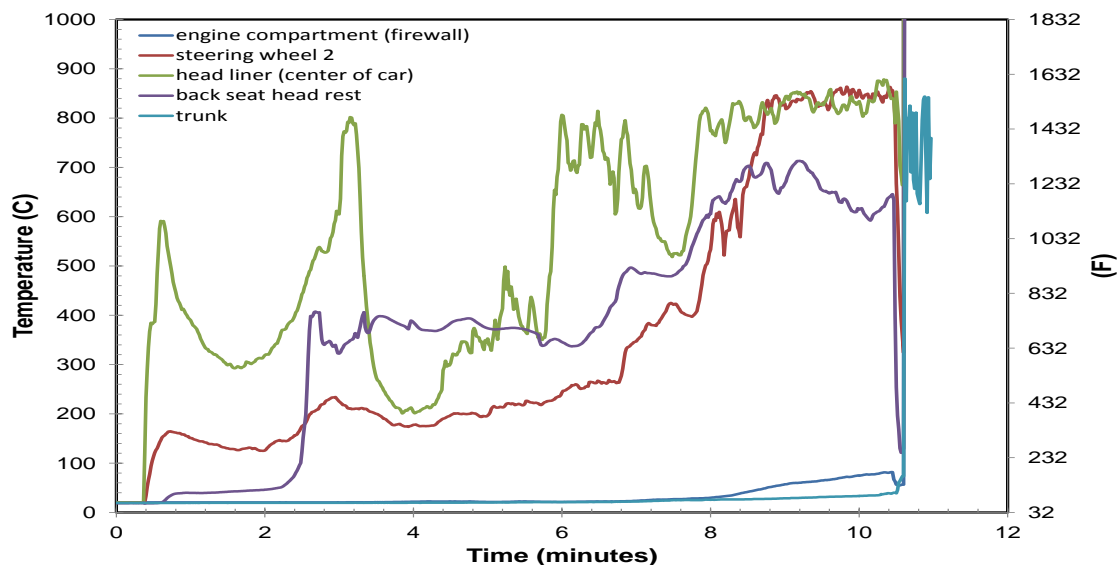


Figure 4. Temperature

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.



Figure 5. PRE (0:13 hr:min), 416_48044, True



Figure 6. PRE (0:13 hr:min), 416_48042, True



Figure 7. PRE (0:12 hr:min), 416_48043, True



Figure 8. PRE (0:12 hr:min), 416_48046, True



Figure 9. PRE (0:11 hr:min), 416_48048, True



Figure 10. PRE (0:11 hr:min), 416_48067, True



Figure 11. PRE (0:10 hr:min), 416_48088, True



Figure 12. PRE (0:10 hr:min), 416_48051, True



Figure 13. PRE (0:10 hr:min), 416_48071, True



Figure 14. 0, 416_48084, True



Figure 15. 4, 416_48064, True



Figure 16. 18, 416_48096, True



Figure 17. 44, 416_48056, True

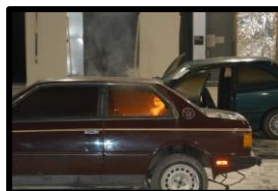


Figure 18. 81, 416_48079, True



Figure 19. 190, 416_48068, True



Figure 20. 238, 416_48089, True



Figure 21. 250, 416_48061, True



Figure 22. 368, 416_48070, True



Figure 23. 372, 416_48087, True



Figure 24. 389, 416_48058, True



Figure 25. 424,
416_48082, True



Figure 26. 457,
416_48054, True



Figure 27. 475,
416_48081, True



Figure 28. 533,
416_48062, True



Figure 29. 537,
416_48078, True



Figure 30. 583,
416_48047, True



Figure 31. 607,
416_48072, True



Figure 32. POST
(0:07 hr:min),
416_48050, True



Figure 33. POST
(0:07 hr:min),
416_48060, True



Figure 34. POST
(0:08 hr:min),
416_48083, True



Figure 35. POST
(0:08 hr:min),
416_48073, True



Figure 36. POST
(0:08 hr:min),
416_48066, True



Figure 37. POST
(0:08 hr:min),
416_48093, True



Figure 38. POST
(0:08 hr:min),
416_48053, True



Figure 39. POST
(0:08 hr:min),
416_48091, True



Figure 40. POST
(0:09 hr:min),
416_48052, True



Figure 41. POST
(0:09 hr:min),
416_48074, True



Figure 42. POST
(0:09 hr:min),
416_48090, True



Figure 43. POST
(0:10 hr:min),
416_48095, True



Figure 44. POST
(0:10 hr:min),
416_48059, True



Figure 45. POST
(0:10 hr:min),
416_48075, True



Figure 46. POST
(0:10 hr:min),
416_48085, True



Figure 47. POST
(0:10 hr:min),
416_48065, True



Figure 48. POST
(0:10 hr:min),
416_48086, True



Figure 49. POST
(0:10 hr:min),
416_48049, True



Figure 50. POST
(0:11 hr:min),
416_48076, True

References

1. The Temperature Handbook, 2nd edition, Omega Engineering, Stamford, CT, 2000.
2. Laboratory Instruction LI001 - Thermocouple, Bureau of Alcohol, Tobacco, Firearms and Explosives – Fire Research Laboratory, Beltsville, MD.
3. Laboratory Instruction LI003 - Digital Cameras, Bureau of Alcohol, Tobacco, Firearms and Explosives - Fire Research Laboratory, Beltsville, MD